Design and Analysis Tools for Deployable Solar Array Systems Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

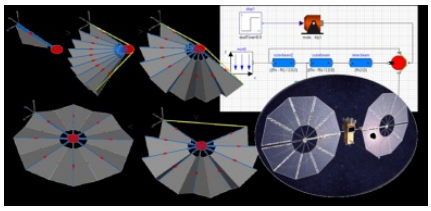
ABSTRACT

Large, lightweight, deployable solar array structures have been identified as a key enabling technology for NASA with analysis and design of these structures being the top challenge in meeting the overall goals of the NASA Space Technology Roadmap. The use of analysis to drive design from an early stage is critical to their success, yet conflicting design requirements and demanding space constraints make traditional design/build/test methods challenging and expensive. The proposed SBIR program focuses on overcoming this through the development of a user-friendly multi-disciplinary design and analysis software toolkit that can rapidly perform parametric studies and design optimization of solar array concepts. The software package will provide a graphical user interface and analysis procedures to evaluate critical performance metrics, while eliminating the unnecessary pre-processing and computational overhead associated with current approaches. Analysis capabilities will include flexible multi-body dynamics, array deployment, modal analysis, and response simulation. Model creation will be simplified through the use of an extensible, hierarchical blockset solution and a library of blocks specific to deployable solar array analysis. The Phase II effort will focus on the development of advanced analysis and design capabilities and further validation of the tool through test-correlated modeling of a state-of-the-art solar array system.

ANTICIPATED BENEFITS

To NASA funded missions:

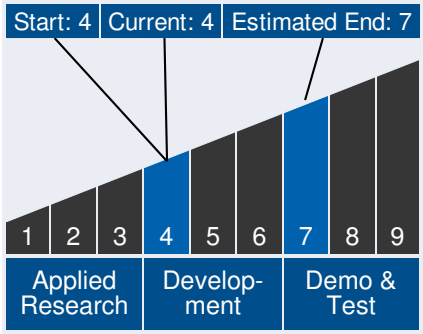
Potential NASA Commercial Applications: The most immediate opportunity for the tools that will be developed under this SBIR is to assist NASA and its contractors in performing design trade studies of large mass-efficient deployable solar array systems. NASA has recently awarded two contractors—ATK and DSS—Phase I contracts to advance their concepts through hardware development and verification testing. One design will move



Design and Analysis Tools for Deployable Solar Array Systems

Table of Contents

Technology Maturity



Management Team

Program Executive:

- Joseph Grant

Program Manager:

- Gary Jahns

Continued on following page.

Design and Analysis Tools for Deployable Solar Array Systems Project

forward to a multiyear Phase II flight demonstration program. The tools that will be developed under this SBIR will allow rapid design trade studies of these systems to be carried out by NASA and the manufacturers so that the designs can be optimized for critical performance requirements such as deployment reliability, stiffness, strength, and control. These studies will allow a more complete exploration of the design space and substantially reduce risk in expensive hardware manufacture and testing on these and future deployable systems. Additional areas of expressed interest for NASA include using the tools for control-structure interaction studies of structures with flexible components as well as simulating thermal-gradient effects on the structure. Control-structure interaction is important for a wide variety of NASA interests, one of which is attitude control. Using a flexible structure in the simulation of the control system dynamics will greatly enhance the accuracy of simulations and provide valuable insight into the actual performance of the control system.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The tools developed in this program will have broader applications than just the design and optimization of solar array structures. Development of the toolset will provide a modular, open-architecture tool that is easily extensible and customizable to integrate with other systems, software tools, and architectures across other industries. The fundamental approach of using Modelica as the core of a lightweight, graphics-based, intuitive, and efficient computational tool for design and analysis can be extended to a wide variety of other structural analysis and design optimization applications including lightweight booms, frames, expandable/inflatable structures, and associated mechanisms. Furthermore, the underlying architecture of the toolset allows it to be easily expanded and/or customized to enable additional analysis solutions, geometry modules, control systems, interactions, and componentry relevant to a vast array of other products. The software will eventually prove to benefit

Management Team *(cont.)*

Project Manager:
- Geoffrey Rose

Principal Investigator:
- Cory Rupp

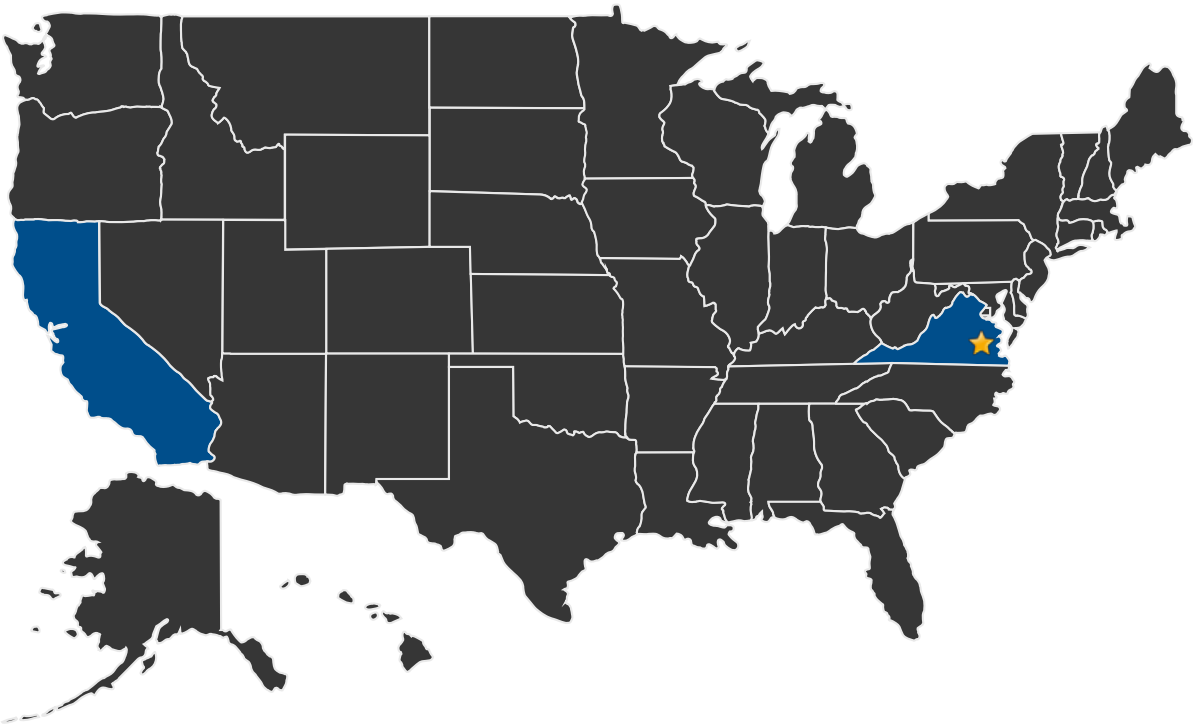
Technology Areas

Primary Technology Area:
Reliably Retractable Solar Arrays (TA 3.1.3.4)

Secondary Technology Area:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)
- Mechanical Systems (TA 12.3)
  - Design and Analysis Tools and Methods (TA 12.3.4)

the design and analysis of any product that has several disparate components that must work in an integrated way. Examples include heavy equipment, robotics (terrestrial and space-based), industrial manufacturing, spacecraft, aircraft, automotive, and energy applications.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- ATA Engineering, Inc. (San Diego, CA)

DETAILS FOR TECHNOLOGY 1

Technology Title

Design and Analysis Tools for Deployable Solar Array Systems